Menlo Park Notebook #236 [N-81-03-11]

This notebook covers the period March-April and December 1881. Most of the entries are by Francis Jehl. The book contains notes and calculations relating to meter experiments and to tests of dynamos and wires. Included also is a summary by Edward L. Nichols of the meter experiments. The label on the front cover is marked "Francis Jehl." The book contains 278 numbered pages. The last few pages have been torn out of the book.

Blank pages not filmed: 106-225, 228-275.

1 : 4°

240

4 : 1 :: 200 : 50

x/y 20/x

x.

4) 200 (5

LIBRARY OF THE

BOARD OF PATENT CONTROL,

120 BROADWAY, NEW YORK.

From Library
GENERAL ELECTRIC
Lit Arc St. Mfg.
May 1, 1896

March 14 1899

Measured a German ship
its resistance was .019 ohms

910 : 30 : x : .0157
970
13090
1683

30) 18.1390 (.60
180
613
30
1800

Run of Cu plates call .6 ohms
plate 26.
.500
150
80.

gm 411.9

Current on at 10.53 am.

The solution is a saturation
of pure (C.P.) of $CuSO_4$.

Candles of lamp 16.
Stopped at 12 P.M.
started at 1.22 P.M.

2 Stopped current on
then at 4.10 Weight 412.1

26,689.3.5

Running 31.55 hr gives 9 milpowe

67
38
40
70
69/2355/3
18 2
55

Started again at 4.55
Stopped at 6.9 P.M

Current on at 9.14.5 412 grams

Set up my Motor The resistance of the shunt I used was 0.1 ohm had the reversor on all night and with eight lamps it went as follows

Shuck at
11.49 AM 1
#2 12.45 P.M 2 56 minutes
~~1040~~ 1/2 hours to 2 1 55.5 minutes
~~2~~

Commenced again at 2.58.
dropped at 4.2
Shuck at 5.8

March 11, 1881.

Summary of Meter Experiments.

— Freezing Points. —

(1) Ordinary solutions $CuSO_4 + H_2O$ freeze just under 0°C.

Addition of Glycerine lowers freezing point.

As much as 40% Glycerine can be added without interfering with the plating process. With 40% Glycerine the freezing point is below −20°C.

The Glycerine increases the resistance very materially.

Influence of strength of solution.

(2) About 20% parts $CuSO_4$ to 100 H_2O is as strong a solution as can be made at low temperatures — (see Watts Dick on Saturation points of $CuSO_4$ solutions)

The rate of the meter is within large limits independent of the strength of solution provided always that the

current remains constant

Influence of temperature upon rate of Meter.

$CuSO_4$ increases in conductivity with the temperature.
(See Niedmann, Hellners Physik Ba IV p 491)
For 18.7 parts $CuSO_4 + 100 H_2O$
Niedmann forms—

Temps.	Res.
0°C	1.60
20° "	0.738
40° "	0.523
60° "	0.384
80° "	0.330

(3) In case of metals - Matthiessen gives formula: {Poggendorff's Annalen 115 p 122.

$$C = C_0 (1 - 0.003674t + 0.0000083442t)$$

where C = Conductivity
C_0 = " at 0°
t = temp^re.

1 3

4

1.077
3.231
735
3.999
1.329
3
3.987

3.33
3.98
4.31

This gives.

Temps.	Res.
0°C	1.00
20° "	1.077
40° "	1.160
80° "	1.329

In consequence of these relations a circuit containing solutions and metals can always be so arranged that its conductivity shall be independent of the temperature.

If we use a 20% Solution of SO_4 of Copper — I find the proper ratio of metal to Solution to be 3:11

The rate of the meter at different temperatures by actual test was found to be. — (When the solution only was changed and the metal) parts of the

circuit remained at room temperature to be;

Solution 18 %.

Oscillations per hour.	Temp.
3.5	0°C
4.1	10°C
4.8	20°C
5.5	30°C
6.2	40°C

From this the compensation can be calculated; by comparison with Wiedemann's results the other errors of the instruments found.

Nichols.

Mar. 16, 1881.

METER TEST

From 2 to 1 = 12 M to 12.15 P.M
" 1 " 2 = 12.15 P.M. to 12.32 "
" 2 " 1 = 12.32 " " 12.45 "
" 1 " 2 = 12.45 " " 1 "
" 2 " 1 = 1 " " 1.15 "
" 1 " 2 = 1.15 " " 1.46 "

Not Certain

" 2 " 1 = 1.46 P.M. to 2.4½ "
" 1 " 2 = 2.4½ " " 2.27½ "
" 2 " 1 = 2.27½ " " 2.47 11/12 "
" 1 " 2 = 2.47 11/12 " " 3.12¼ "
" 2 " 1 = 3.12¼ " "

From 2 to 1 = 3.50 5/6 P.M to 4.21 11/12 P.M
(Engines stopped twice - 4")

From 1 to 2 = 4.21 11/12 P.M to 4.47¾ P.M
" 2 " 1 = 4.47¾ " " 5.13½ "
" 1 " 2 = 5.13½ " " 5.36 11/12 "
" 2 " 1 = 5.36 11/12 " "

Test on large Dynamo

March 16

magnet	deft armature	Speed	REMARKS
0	3-3	240	Permanent magnetism
14-13.5	14-13.5	244	
13.0	24.5-24	222	
30	37-37		
35	38-38		
	42-42		

magnet	armature	speed	March 16 1881

magnet armature speed)

Water experiments with March 17 1881

No 1 Weight 669.2 grams
time

Date March	Weight 669.2	
18	675.6	369"

No 2 weight 665.1 grams
time

March		
17	665.1	
18	625.1	368"

22 No 3 weight 598.9 grains

Date		
17	598.9	
18	599.	368

No 4 weight 804.6 grains 23

17	804.6	
18	804.8	367

No 5 weight 792.3 grams

Date		
17	792.3	
18	792.4	367

No 6 weight 690.

No 6		
1	690	
18	690.1	366

No 7 weight 714 grams

17	714	
18	714	366

No 8 weight 654.8

Date		
17	654.8	
18	654.8	366

Copper Plate put into a solution without Current

March 18	weight	411.8 grams
19	"	411.9
March 26		411.7
29		411.9
April 13		412.1

15) 15 | 3.4 (5

Copper Plate put in water

March 18	weight	634.7 grams
19		634.7

Copper pellets in same solution as tests are made

15 925.12 grams 2.8!
18 924.77
19 634.15 grams —

Sunday March 26 1911

260 of 65° 71 27 B

1000
260
740) 2600 (.35
2220
3800

1000
274
726) 2740 (.37
2178
5620
5082

1000
566
434 (434) 566 (1.3
434
1320
1302

566

.37
3
1.11
37
1.11 1.

.1.

3x3 = 9
3x

1x1
1+1

.23
3
.69

.10
3
1.3 .3
13) 50 (.2
26
40

Finding Mult 26 at 617 0 1.568

1432

568) Tally .76 plus

4 : 2 : 568 : 8 : 1

568) 4320 (.8
44

568) 4320 (.76
3976

3440
3408

.76
.24
304
152

1.00 2

1) .1824 (.1

.37
2
.74

.37
.76

.37
.74

4

.37
.76
1.13

.37
.76
222
259
.2812

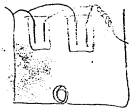
1.13) .2512 (.24
226
552
552
1000

24
72

.76

3
2
1.1812

$\frac{9}{16}$ or 14 C.M and a half peak between it, 4 m wide $3\frac{1}{2}$ long



.15
.15
.60

.015
.150

~~.997~~ 900

900 : 100 :: x : .0147

.0147
900
100) 13.230 (.160
100
323
300
23

1000
895
105

895 : 105 :: x : .0147

.0147
895
735
1323
1176
13.1565

105) 16.7365 (.15
105
623
525

both cell = .15 ohms

963
0.67

963 : 37.8 × .067

963
.067
5741
7704
963

37) 16.00.81 (.48
148
320
296

75.8 = 1

75.8) 1.000 (.013
758
2420
2274

.15
3
.45
75
.60

75.8 pitt = 1 ohms

15) 45 (3
45

45) 75.8

100) 75.8 (.758

.758

.758 ×
45
3790
3032
34.110

March 27 1881

Cow cell plate
weights 612.7 grams
612.7

Started at 11.4 AM
Stop at 6.4 P.M.

609.4 grams
610.6

610.6
609.4
1.2

other plate weights
348.7 grams
339.6 grams
340.

340
339.6
.4

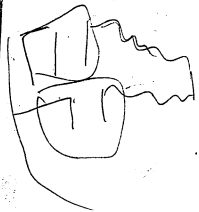


Plate No 7

855. grains
965.5 grains
855
1105

32

19.44 mg
min

.18.3 grains

.305

.005 grains lost
.0647
.0005
2300
.00002635 well
223

.2 × 3
.326

Plate No 6

688.7 grains
799.0
688.7
110.3

18.3 grains antron

110 grains in 6 hours
18.3 ant

60) 18.3 (.305
180
300
300

.326
60
19.560
60
1173600

60) .305 (.005
300
5
60
300
300

5
326 65

.005
.305

.826

$$C = \frac{\varepsilon}{R}$$

$$CR = \varepsilon$$

.005
.000 5 mi
60
hour 1 8.0 0 0 mi
10 hour 1 8 0 0 0 0

4/180
45 Tally
135 mile

1 X .01 / .01 + .6

Cell 1 = .01 / .61

1 X .6 / .01 + .6

.60 / .61

61) .326 / 305 / 21

.005 / .305

.3001 m / 60 / 18.001

Tuesday March 25 / 1881

Our

C through cell =

$1 \times \frac{.01}{.01 + .6} = \frac{.01}{.61}$

C through S =

$1 \times \frac{.6}{.01 + .6} = \frac{.60}{.61}$

$1^{mg} = \frac{.015^{gr}}{45}$ $\quad$ $\frac{135}{.015}$

$\frac{675}{60}$ $\quad$ $\frac{675}{135}$

.675 grains $\quad$ 2.025

.326 mm per 8''

.61) .326 (.005 mm per second

.61

.005

60

.300 per minute

60

18.000 per hour

10

4) 180.000 10 hours

45 min Tally cell

3

135 min

45 mg or .675 grains 10 hr

gr

2.025 or 135 mg = 10 hr

Coun. Q in

with

180 mg in 10 hr through cell and C.R.

4/180.
45 goes in tolly cell
3
and 135 lost in R

$\frac{1}{4}$/45
$11\frac{1}{4}$ mg in tolly cell

$\frac{11\frac{1}{4}}{3}$
$33\frac{3}{4}$ goes in ordinary cell

$11\frac{1}{4}$
.015
5 5
$1.13\frac{3}{4}$
$.168\frac{3}{4}$ gr

$33\frac{3}{4}$
.015
165
33
$11.\frac{1}{4}$
.406$\frac{1}{4}$

11.25 mg
168.75 gr } 10 hr

33.75 mg
406.25 gr } 10 hr

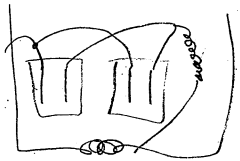
2/33.75
16.87 at 5 hr
30
506.10

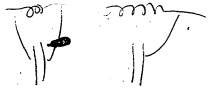
133.

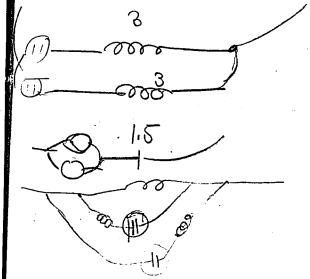
$\frac{11}{22}$.

$\frac{13}{4}$

70
30
2100.
12
4200
2100
2520






8
3
1.5

Thursday 1911

Length of German Silver strip

$18\frac{3}{8}$ long & $1\frac{1}{4}$ inches wide

Wt. of piece of .0028 gauge Cu wire in the Reduced Resistance

.0187385
830
562155 0
1499080
170) 15.5529550 (.09144
1530
252
170
829
680
1495
1360

April 7.

Test of brass resistance wire

D = .051

L = 10 ft 7½"

T = 78°.87 = 26°C

R = 830 − 170 = .207406 Ohms
.0187385

830 : 170 : X : .0187385
830
55155 0
1470800
170) 15.5259550 (.207
1400
1259
1190
.207406
690
680
1050

.0
4
6

Ans = .207406 of an alum

.051
.051
.051
.258

.002601

.002601 = D²

~~9.83~~

9.829 × 10.58
.002601

9.829
10.58
78632
49145
9829
10399042
.002601 = 39981.

7/12 | 7.0
6.0
1.00
.86
.14

.58

.002601 | 103.990820 (.718
4 04
4.258
829
9.718
9.880
21 | 9.658
9.829

.002601 | 103.990820 (39981.0
78 03 × × × ×
25 9 80
23 4 09
25 5 18
23 4 09
2 1 09 2
2 0 8 0 8
2 8 4 0
2 6 0 1
2 3 9 0

26 C

.0038240
26C
22944
7648
1.0999424

39981.
1.10

39981.
1.10
39981 0
39981
4397901 0

9.829 × 10.58 × 1.10

512
51
51
255
2601 / 9.82900 .00377
7803
20260
18207
26530
18207
2323

.00377
10.58
3016
1885
377
.0398866
1.10
3988660
398866
.04387526 0 C. 1 L.

9.829
10.58
78632
49145
9829
103.99082
1.10
10399082
10399082

51
51
51
255
2601

2601) 1143.89920 (.043979
10404
10379
7803
25469
23409
20600
18207
23982
23409
5230
.00430
.0043
10.58
2344
2150
43
.045497

1000) 4.3052 (.00430
3052
3000
52
520

2.1 (

.043979 Res of pure Copper at 75° Di = 51 length 10.58 ft

of Sample to be tested length 10.58 ft Di = 51

Res = ~~.207406~~ .09148

~~.043979 : .207406 :: x : 100~~

~~.207406) .043979 (.2~~

~~.2) .04 (.2~~

~~.04~~

.043979 C.P.C

.09148 Cupe

.09148) .043979 (.48 per cent

36592

7387.0

7318.4

3

14.2000

60) 120 (1.2

26

72

144/72

1.2

5

6.0

1.2

2.4

1.2

1.2

2.4

14.20

1.0

2

$\frac{1}{6}$ of an ohm for distribution

$\frac{1}{6}$ for return

$\frac{1}{10}$ for end

were no .028 = 75.871 per ohm

10) 75.80 (7.58 = .1 ohms

70

58

50

80

6) 75.8 (12.63 feet = 1/6 of an ohm.

6

15

38

30

20

10) 12.6 (1.26

10

26

20

6

1420 cc

14

1420 cm — 100 ohms
wire with Insulation
.010 Dia
Circumference 2.5 cm
length of Spool 2 inches

2.5 c.m
2000
5000
2
10000

10)2000

2.5
2000
5000
1500

6)60 (.1

1/6)10 (.16
6
40

1/10)16 (.1
#

1/7)15 (.14
30

1/8)10 (.2
2

1/9)11 (.11
1

100) 200 (.02
.04

100) 300 (3

300 = 2V
1 = 150

100) 2.00 (.02
2 00
.04

100) 150 (

1.5
6.0
2

100) 332 (3.32
300 2
32 6.64

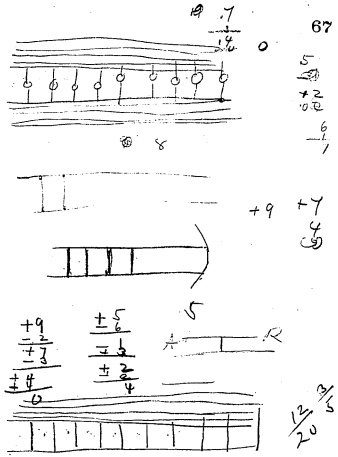
3
332.5
326.5
6.0

~~325~~

332.5 Com
326.5 Sud

334.5
325
6.0

Made 10 100 ohms Bobbins and soldered them on to the wire. 1/6 of an ohm and 1/6 return. Making a resistance of 2/6 of an ohm. Ev... by galvanized gold the fall of 2%. Then made one 100 ohms spool and total R of line 12 of and ohms and also got a fall of 2%.



13
14
15
10 16
90
150
15.50

$C = \frac{\mathcal{E}}{R}$ $\mathcal{E} = CR$ $R = \frac{\mathcal{E}}{C}$

$CR = \mathcal{E}$

$\frac{1}{5}$ $\frac{1}{12}$ $\frac{1}{60}$

$\frac{1}{5 \times 12}$ .005

45
55

April 14 1881

Large Cu 676.1 grains 695.8

Sm. Cu 462.1 grains 472.

695.8
676.1
19.7 grains

472.0
462.1
9.9

9.9

Large 702
695.8
6.2

4738
4720
1.8

Sm 473.8 477.8

Large 702. 714
702

Large 714 725½ grs

Sm 477.3 480.3

Large 725½ 480.3
477.3
3.0

Sm 480.3

Large 747.8

Sm 480.4

at 8 p 7°.

1000
263
737

263 : 737 :: K : .018738

263
56214
112428
37486

18) 62 (3.4 737 | 4.02709 4 .005
49
2638
737

K

1.8) 6.21 (3.4
5
6.0
8

1000
368
632

3) 15.6 (2.9
27
3.4
3.3
702

3.4 times

.0187 38
368
149904
102428
56214

35) 120 (3.43
105
150
140
100.2

6.7755 × 4 .010
132
4755

Large 147.8 — 147.8 − 125.7 = 22.1

Sm 486.4 − 480.3

61) 221 (3.62
183
380
366
140

Large 877.1 — 877.1 − 747.8 = 129.3 qr

Sm 521.8 − 486.4

35.4) 1293 (3.6
1062
2310
2124

ft
1145.4 to the ohm

1145.4) 100000 (.00087
91632
083680
91632
10

1 ft of no 12 wire = .000087 ohms

12) .000522 (.000435
48
42
36
60

.000435
75
2175
3045
4) .032625
.008 ohms

Shunt R

1000
372
628

372 : 628 : X : .018385

372
36770
128695
115155

~~372~~) 12838220 (.0

~~628) 12838220 (.02~~

.018385
372
374770
131169.5
562155

628) 6970 6720 (.01109 R=8
628
690
628
6267

1000
376
624

.018385
376
11243.10
131169.5
562155

757

624) 8.04567.60 (.0112 9 R.S.
624
805
624
1616
1248
5687
5596
910

.00004 47975
20
.000959500

.011291
.000959
.011332 Ro of Shunt

at 757.

2.5
3
7.5
3.5
8.75
2.5
26.25 Sq in Sur.

16
2
3.2

6.9
1.

.249
6
1.494

.249
149
2241
996
249
.37101

.249
1.49
1.739

1739) 371.01 (.21
3478
2321
1739
582

3
63
21
.84

at 75°7
Pyflange Cu Pil .249 ohms

1000
70
930 : 70 : X : .0187385

.0187385
930
562150
16875465
4
43
3

70) 17.436850 (.249
140
343
280
630
630

1000) 5.1850 (.00525
1170

Jan @			
50.25	929.5	38	939
50	932.5	36.5	938
49.75	937.		
49.50	938.5		937
49.25	941.	29	938
49	943		
48.5	946.5		
48	947.		
47.	947		
46.5	941.5		
46	945		
45	942.5		
44	942		
43	941.5		
42.5	939.5		
41	940		
40¼	939		
39¼	938.5		

Sep 27C 953
Sm 26 994 = 3

§ 2 ... Numbers after Entry

Solution Temp +20°C = +16°R = +68°F

10 ohms ohmic cell

Get the $\sqrt{4096}$

)40 96 (64
12) 4 96 (4
16

124
4 6

5 8 2 1 6

)5 8 2 1 6 9 (765
49
14) 9 2 1
7 8
152) 8 1 6 9 (5
7 6 0

)5 8 2 1 6 9 (763
49
146) 9 2 1 (
8 9 6
1523) 4 5 6 9 (
4 5 6 9

178
00
4

)9 5 6 4 8 4 (92
81
182) 1 4 6 4 (
1 3 6 4
184) 1 0 0 8 4

)9 5 6 4 8 4 (978
81
187) 1 4 6 4 (
1 3 0 9
1948) 1 5 5 8 4 (
1 5 5 8 4

57 19 89 69

)57 19 89 69 (7566
49
144) 8 1 9
7 2 8
1506) 9 9 8 9 (
9 0 3 6
15126) 9 5 3 6 9 (
9 0 7 5 6

57798969 (7563
49
145) 819
725
1506) 9459
9036
15123) 45369

√68492176 (8276
64
162) 449
324
1647) 12521
11529
16546) 992176
992176

) 101801 81 (1009
29) 0180
) 00180

) 101801 81 (1009
20) 0018081
81

2) 0180

011
200) 0180 81
180 81
2018)

√101801 81 (100
20) 01
200) 0180 81
) 101801 81 (100
20) 01
) 0180

101801 81 (1009
20) 01
2009 200) 180
9018) 180 81
180 81

)9803161 (9

9)9803161 (31 31 61

67) 80
67

623) 1931 (
1869

6261) 6261
6261

)152 27 56 (1 2 3 4

22) 52
44

243) 827
724

2464) 9856
9856

)1018081 (100

20) 01

200) 0180

2009) 18081
18081

~~when~~

When the current first enters a deposition cell, the cell has a high resistance and if the current remains constant its resistance will gradually diminish. This can be verified by actual experiment, put the deposition cell in one arm of the wheatstone bridge and get it balanced and watched. the effect, a current will gradually begin to flow and you will have to keep the bridge balanced out all the time

your resistance is constantly diminishing. This phenomenon I describe as follows.

When the current first enters a cell, its resistance is that of the fluid from plate to plate, but when the current begins to flow, and by electrolysis it takes these small particles of copper from one plate to the other it is evident that the resistance is diminished therefor its resistance being diminished a stronger current flows and this takes or deposits more

than before copper, which again decreases the resistance and so continues until it reaches its limited point, where it retains a constant resistance provided the density of the solution is always the same, and the distances between the plates is the same.

P.S. It will be noticed that when we first measure the resistance we see its resistance will diminish rapidly and gradually decrease, the decrease being lower

and slower untill it reaches its maximum point.

F. J. Le

Large Meter at 24C =

217 : 1000 - 217 :: x : 1 = 29

Small meter 24C

517 : 1000 - 517 :: x : 1 . 1.104

The above action may be made clear by supposing that there electrolytic takes place that some sulphuric acid

is set free by the deposition of copper, and that this forms a good conductor this again combines with copper & the other sides equal forms sulphate of copper. At first the action is not so rapid as when the current has been on a little while

F. J.

910 : 90 :: K : .018738
910

18738.0
168742

17061580

90) 17.061580 (.189
90
8 06
7 20
8 60
8 10

18.5°C

.018738
920

374760
168742

80) 17.24897 60 (.215
12 9
4 08

21
3
63
21
184

$$.2 \quad \frac{a \times B}{a + B}$$

1+
1.2) 2.0 (.165
12
80
72
60
60
6

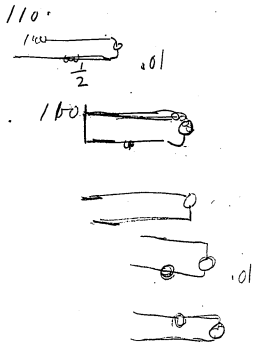
.165
3
495
165
.660

33
9
1/2

$$C = \frac{\varepsilon}{R}$$

$$CR = \varepsilon$$

$$R = \frac{\varepsilon}{C}$$



Lost on 101 of an abus chart

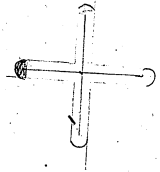
1
5

20

80

5

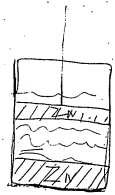
5 5 5
5 5
5 5
5 5 5

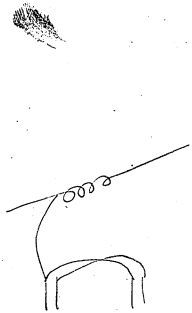


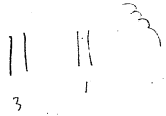
June 4 1887

Test of three pieces of Copper

~~first bar also~~






3
1

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278 Lower depend no 2

Dec 25 1891

Cow	1	2.25
	2	2.31
	3	2.24
	4	2.36
Top end	1	2.28
	2	2.20
	3	2.32
	4	2.22
Bottom	1	2.03
	2	2.03
	3	2.04
	4	2.12

470) 530 (1.5
470
600

530
470) 3150 (6.7
2820
3600
3290
50

19gm = 15.43
50
77 1.50.
900

4 15 2 15
60
60 1500
9 0.00